

A REVISION OF THE OCTOPODINAE
IN THE COLLECTIONS OF THE
BRITISH MUSEUM

GRACE E. PICKFORD

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ZOOLOGY
LONDON: 1955

Vol. 3 No. 3

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Pp. 151-167.

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THE BULLETIN OF THE BRITISH MUSEUM
(NATURAL HISTORY), instituted in 1949, is
issued in five series corresponding to the Departments
of the Museum, and an Historical Series.

*Parts will appear at irregular intervals as they become
ready. Volumes will contain about three or four
hundred pages, and will not necessarily be completed
within one calendar year.*

This paper is Vol. 3, No. 3 of the Zoological series.

PRINTED BY ORDER OF THE TRUSTEES OF
THE BRITISH MUSEUM

Issued June, 1955

Price Five Shillings

PART I.—FURTHER LIGHT ON THE OCTOPUS RUGOSUS PROBLEM

By GRACE E. PICKFORD

IN spite of the efforts of Robson (1929), which form a landmark in the history of octopodan taxonomy, the *Octopus rugosus* problem remains unsolved, an outstanding source of confusion obscuring the correct identification of small, rough, *vulgaris*-like specimens from all parts of the world. Some years ago the writer reviewed the western Atlantic forms which had been, or could be, assigned to *Octopus rugosus*. It was possible to show that no such species can be found in American waters and that western Atlantic specimens previously referred to it were either *O. vulgaris* or, occasionally, belonged to one of the other Caribbean species (Pickford, 1945, 1946).

It is believed that the problem can best be solved by a zoogeographical approach, *pari passu* with increasing knowledge of each local fauna to the point that makes the recognition of its component species a matter of certainty. Through the work of Voss (1950, 1951, etc.) and the author we have now arrived at this state of knowledge of the American east coast fauna. However, the situation in other parts of the world is less satisfactory. Octopodan taxonomy has always been hampered by the lack of adequate series of specimens collected from any one locality and this, together with the confusing effects of different states of preservation, has made recognition of the limits of variation within a single species all but impossible.

In the present contribution an attempt has been made to clarify the status of those specimens from the eastern Atlantic and South Africa which Robson identified as *O. rugosus* and which are now in the collections of the British Museum. A survey of bodily characteristics, irrespective of species assignation, is given in Table I. It will be seen that only 7 of the 22 specimens are sexually mature, 4 are well grown but immature, and 11 are juvenile. In a difficult problem of this nature it is obvious that no definite conclusions can be based on juvenile, nor even on sexually immature specimens, except in so far as they can reasonably be assigned to adult forms with well established characteristics.

Octopus rugosus, as it is generally understood, is a species closely resembling *O. vulgaris* but smaller in size; the head is broader, the arms shorter, and the rough, finely granulated skin is darkly reticulated with black. None of these characters, taken singly, can be used with any degree of certainty for the separation of the two species. Taken together the resulting picture is indistinguishable from that of juvenile and immature specimens of *O. vulgaris*, so that it may be conjectured that *O. rugosus* is merely the young of *O. vulgaris* (Pickford, 1945). This point of view is that taken by the writer who believes that it is necessary to *prove* that an Atlantic specimen assigned to *O. rugosus* is not a young *O. vulgaris* before it can be considered to belong to any other species; a *rugosus*-like specimen should be assigned to *O.*

vulgaris unless there is conclusive evidence that it does not belong to this species. Robson, on the other hand, used the name *O. rugosus* as a hold-all to receive those *vulgaris*-like specimens about whose identification he was uncertain and, as a result of this policy, it is not surprising to find that the majority of his eastern Atlantic specimens, as indicated above, are juvenile or immature.

We may approach the problem from another angle. Bosc's *Sepia rugosa* came from Senegal and the type is lost. Lamarck (1799) gives no locality for the two specimens to which he gave the name *O. granulatus*. He points out that this species may be merely a variety of *O. vulgaris* and concludes that it is probably the same as Bosc's *rugosus*. The types are lost and, in the absence of evidence to the contrary, it appears advisable to relegate the name *O. granulatus* to the synonymy of *O. vulgaris*. A similar conclusion is probably justified in the case of *O. tuberculatus* Blainville, the type of which is also lost. However, since the species is from Sicily, its status should be re-examined in connexion with a more thorough taxonomic study of the Mediterranean population.

It must be pointed out that the original specimens of *O. rugosus* and *O. tuberculatus*, not to mention numerous other specimens referred by various authors to these species or to *O. granulatus*, were reported from geographical areas in which *O. vulgaris* is known to occur. Therefore, *O. rugosus* (to confine the discussion to one of the three problematical forms) is *not* a geographical race or subspecies of *O. vulgaris*. Either it is a distinct species or it is inseparable morphologically from the extremes of the *O. vulgaris* population. This is an important consideration. If two species occur together in the same geographical area they must form two separate breeding populations.

The search for *O. rugosus* is therefore the search for a West African *vulgaris*-like sibling species which is distinct as a breeding population from *O. vulgaris* with which it is sympatric. As the result of previous investigations (Pickford, 1945, 1946) it can definitely be stated that *O. rugosus* does not occur in the western Atlantic but the problem of Indo-Pacific forms that have been assigned to this species awaits further clarification. However, if the existence of a true *O. rugosus* cannot be established in the eastern Atlantic it is highly improbable that anything recorded from Indo-Pacific waters could legitimately be assigned to this species.

The study of the British Museum specimens reviewed below leads to the following conclusion :

(1) Nearly all specimens from the eastern Atlantic are probably or certainly referable to *O. vulgaris*. It is probable that the correct assignation of the juvenile specimens will always remain in doubt but 6 of the 7 adults present no features which would permit their separation from *O. vulgaris*.

(2) Among the series there is one juvenile specimen from Madeira that has a distinctive pattern of zebra bands on the arms. Although the characteristics (Table I, B.M., 1898.5.10.2) are similar to those of *O. vulgaris* the correct assignation of this specimen must remain in doubt.

(3) One specimen from the Cape Verde Islands (1889.4.24.17), a mature male, certainly represents a distinct species on account of the length of the ligula which is quite outside the range for *O. vulgaris*. A similar male and also a female that

apparently belong to the same species have been described by Adam (1952) from the Cape Verde Islands as *Octopus* sp. The question arises whether these individuals should be arbitrarily assigned to *O. rugosus*, with which they show some general agreement, or whether it would be preferable to designate them by a new name. The original description of *O. rugosus* does not permit recognition with any degree of certainty. Bosc's figures (1792, Figs. 1 and 2), if correctly drawn, show an animal of 42 mm. mantle-length with moderately long arms (MAI 32) and an unusually shallow web (WDI 13.5); the suckers are of moderate size (SnI 9.5) but none are specially enlarged. In favour of assigning the Cape Verde specimens to this species is the geographical area from which it came, as well as the general appearance and bodily proportions, except for the shallow web. The only contrary evidence is the shallow web and the uncertainty whether Bosc's *O. rugosus* was not, after all, just a young *vulgaris*. For the sake of clarity and to avoid the confusion that might result from the use of a name which is, by now, so clouded in obscurity, it has seemed preferable to propose a new name for this Cape Verde species.

(4) The problem of the specific affiliation of the South African *rugosus*-like population remains unsettled. The individuals that have been examined, from the Cape Province and Natal, appear to belong to the same species and to represent a moderately uniform group. Robson admits (1929, p. 59) that true *O. vulgaris* occurs in South African waters. The two males, from Port Elizabeth and from Natal respectively, have the characteristic minute ligula of *O. vulgaris*.¹ Massy (1925) found the same feature in males which she identified as *O. granulatus* in the collections of the Natal Museum (LLI 1.7 and 1.65 respectively, calculated from her measurements). There is a small but possibly significant detail regarding the repeated reversal of the direction of coiling of the horn in the spermatophore of one of the males (B.M., 1890.9.4.4), but our information concerning the range of variation in spermatophores of *O. vulgaris* is inadequate to assess this feature. Also the females, with ripe ovaries, are unusually small for sexually mature females of *O. vulgaris*; but this again amounts to no more than a suggestion. Possibly the South African forms represent a geographical race or subspecies of *O. vulgaris* with these slightly different features. Such a conclusion could only be confirmed by the statistical analysis of a long series of specimens.

A detailed account of the specimens follows:

DISCUSSION OF SPECIMENS WHICH ARE PROBABLY OR CERTAINLY REFERABLE TO *OCTOPUS VULGARIS* LAM.

ENGLISH CHANNEL

(1) B.M., 1927.2.10.2. *Octopus rugosus* (Bosc), Robson (1929). Plymouth. C.92.

It was pointed out in a previous paper (Pickford, 1946) that this specimen is clearly a female of *O. vulgaris*. I take this opportunity to publish the characteristics listed in Table I and to call attention to the following features: the arms are un-

¹ Attention must again be called to Robson's mistake in tabulating the ligula-length indices for *O. vulgaris*. It appears that in this one case he referred the length of the ligula to the mantle length instead of to the length of the hectocotyliised arm, thus giving misleadingly high values (see Pickford, 1945).

usually short and the web rather deep but the suckers and gills are normal; there is a very conspicuous lateral seam round the mantle, no doubt an accident of preservation; the ovary is quite small and the ova are minute.

TABLE I.—*Characteristics of specimens from the eastern Atlantic, and South Africa which were referred by Robson (1929) to the species Octopus rugosus (Bosc), in the collections of the British Museum.**

| B.M. No. | Sex | ML | MWI | HWI | MAI | WDI | SnI | Gill |
|---------------------------|--------|-------------|------------|------------|-------------|---------|--------------|-------------|
| <i>English Channel</i> | | | | | | | | |
| 1927.2.10.2 | ♀ imm. | 70 | 79 | 51 | 49 | 39 | 14.3 | 11 |
| <i>Mediterranean</i> | | | | | | | | |
| 1867.3.27.9 | ♂ juv. | 21 | 67 | 72 | 35 | 15 | 8.6 | 8.5 |
| <i>Madeira</i> | | | | | | | | |
| 1898.5.10.2 | ♀ imm. | 32 | 78 | 69 | 27 | 21 | 11.0 | ca. 8 |
| 1912.12.31.118 | juv. | 8 | — | — | — | — | — | — |
| 1912.12.31.119 | juv. | 6.5 | — | — | — | — | — | — |
| <i>Canary Islands</i> | | | | | | | | |
| 1954.2.25.1 | juv. | 8.5 | — | — | — | — | — | — |
| 1954.2.25.2 | juv. | 8 | — | — | — | — | — | — |
| 1954.2.25.3 | juv. | 6 | — | — | — | — | — | — |
| <i>Cape Verde Islands</i> | | | | | | | | |
| 1851.1.24.1 | ♀ imm. | 50 | 84 | 70 | 28 | 24 | 16 | 8 |
| 1855.9.29.2 | ♂ juv. | 31 | 68 | 56 | 31 | 21 | 9.7 | ca. 8 |
| 1889.4.24.17 | ♂ mat. | 24 | 92 | 71 | 40 | 28 | 8.3 | 9 |
| <i>Ascension</i> | | | | | | | | |
| 1889.4.24.14 | ♀ imm. | 57 (55)† | 88 (91) | 73 (73) | 32 (24) | 28 — | 14 (12.7) | ca. 10 — |
| <i>West Africa</i> | | | | | | | | |
| 1928.3.17.1 | ♂ mat. | 24 | 58 | 63 | 21 | 21 | 16.7 | ca. 6-7 |
| 1928.3.17.2 | juv. | 13 | 46 | 62 | — | — | 11.5 | — |
| 1928.3.17.3 | juv. | 15 | 93 | — | — | — | 15.3 | — |
| 1889.4.24.15 | juv. | 7.5 | — | — | — | — | — | — |
| <i>South Africa</i> | | | | | | | | |
| 1890.9.4.4 | ♂ mat. | 30 | 77 | 74 | 27 | 23 | 15 | 8.5 |
| 1924.9.9.11 | ♂ mat. | 41 | — | — | — | — | — | — |
| 1924.9.9.12 | ♀ mat. | 45 | — | — | — | — | — | — |
| 1924.9.9.13 | ♀ mat. | 59 | — | — | — | — | — | — |
| 1926.10.20.30 | ♀ mat. | 27 (28)‡ | — (86) | — | — (34.5) | — | — (10.7) | — |
| 1889.4.24.18 | juv. | 12 | — | — | — | — | — | — |

* Two females from the "South Coast" could not be found (B.M., 1872.2.3.12-13). Three specimens (1865.5.23.1) from an unknown locality omitted. Data based on new measurements unless otherwise indicated. Symbols as in Pickford (1945).

† Data from Hoyle (1886).

‡ Data from Massy (1927).

MEDITERRANEAN

- (2) B.M., 1867.3.27.9. *Octopus rugosus* (Bosc), Robson (1929). Mediterranean, purch. of Mr. Cutter. C.104.

This is a very young male, not a female as listed by Robson. As far as can be determined it is probably referable to *O. vulgaris*.

MADEIRA

- (3) B.M., 1898.5.10.2. *Octopus rugosus* (Bosc), Robson (1929). Porto Santo, Madeira, H. S. Wellcome Esq. C.86.

This specimen, an immature female, is remarkable for its coloration. There are light and dark zebra bands on the arms and it is very dark and blotchy on the back and head. The ovary is undeveloped but has moved to a ventral position and is possibly rather advanced for a *vulgaris* of this size; the ova are minute. The jaws have been dissected out and the radula is mounted on a slide. The bodily proportions are similar to those of a typical *vulgaris* but on account of the peculiar coloration I hesitate to refer the animal to this species. It will be necessary to await further collections from this region to establish the existence of a form with banded arms and, until such time, it may be considered to be merely an unusual specimen of *O. vulgaris*.

- (4) B.M., 1912.12.31.118 and 119. *Octopus rugosus* (Bosc), Robson (1929). Pedro de Malha, Porto Santo, Madeira, 60 fathoms, R. Kirkpatrick Esq. C. 152-153.

Two very young specimens with the characteristic rhomb of 4 papillae on the back commonly seen in juvenile specimens of *O. vulgaris*; probably correctly referred to this species.

CANARY ISLANDS

- (5) B.M., 1954.2.25.1-3. *Octopus rugosus* (Bosc), Robson (1929). Canaries, R. McAndrew. C. 100-102.

Three very young specimens, probably all referable to *O. vulgaris*. The two larger specimens each have the characteristic rhomb on the back.

CAPE VERDE ISLANDS

- (6) B.M., 1851.1.24.1. *Octopus rugosus* (Bosc), Robson (1929). St. Jago, C. de Verd, Ch. Darwin Esq., No. 122. C. 85.

An immature female, very dark, mottled and rough. The ovary is small and apical; the ova minute. The jaws have been dissected out. The suckers are large, as in *vulgaris*, the arms moderately long and the web moderately deep. There seems to be no reason why this specimen should not be assigned to *O. vulgaris*.

- (7) B.M., 1855.9.29.2. *Octopus rugosus* (Bosc), Robson (1929). St. Vincent, Mr. MacGillivray coll. C. 119.

This specimen is an immature male. The head is rather warty, the body smooth. The total absence of a hectocotylus at a mantle-length of 31 mm. indicates that it belongs to a large species and there seems to be no reason why it should not be assigned to *O. vulgaris*.

ASCENSION

- (8) B.M., 1889.4.24.14 *Octopus occidentalis* Hoyle (Steenstrup MS), Hoyle (1886); *Octopus rugosus* (Bosc), Robson (1929). Challenger Coll., Ascension, April 1878. C. 69.

This specimen, an immature female, is the *type* of *O. occidentalis* and was described by Hoyle (1886) in the Challenger Reports. In its present state it is very dark and hard. A comparison of its present measurements with those given by Hoyle (Table I) indicate that a very considerable shrinkage of the arms has taken place during sixty years of preservation (the specimen was examined by me in 1946) but the length and proportions of the mantle and head are little changed. The longest arm, the second left, now measures about 180 mm. whereas Hoyle gives a length of 230 mm. No doubt his measurements, which represent the condition of the specimen when it was in a better state of preservation, should be accepted.

Robson could find no reason why this specimen should not be assigned to *O. rugosus* and I can see no reason why it should not be assigned to *O. vulgaris*.

WEST AFRICA

- (9) B.M., 1928.3.17.1. *Octopus rugosus* (Bosc), Robson (1929). Old Collection (Rich), West Africa. Bears manuscript name "*Octopus rugosus* var. *longimanus*. Type." C. 260.

This is a mature male, very dark in color. The bodily proportions are those of *vulgaris* (Table I) the ligula (Table II) is minute and typical of *vulgaris*. The gills are very damaged and the low estimate of the number of gill lamellae may be due to this condition. Spermatophores were removed from Needham's organ; the length (9 mm.) gives an index of 37.5, which is typical of *vulgaris*. The horn is very slender and measures about 4 mm. in length; there are 40 to 50 spiral turns, partly uncoiled; only the distal extremity of the horn, proximal to the middle piece, is not coiled. This last mentioned feature is not characteristic of a well preserved spermatophore of *vulgaris* but the partial uncoiling and poor state of preservation may well account for such a condition (compare Adam, 1952, Fig. 53B). There seems to be no reason why this specimen should not be assigned to *O. vulgaris*.

- (10) B.M., 1928.3.17.2. *Octopus rugosus* (Bosc), Robson (1929). Sierra Leone, W. P. Lowe. Bears manuscript name "*Octopus rugosus* ? var. *longimanus*." C. 262.

A juvenile specimen, rather warty, with 4 dorsal papillae in a rhomb on the back. Probably referable to *O. vulgaris*.

- (11) B.M., 1928.3.17.3. *Octopus rugosus* (Bosc), Robson (1929). Murray Town, Sierra Leone, W. P. Lowe. C. 371.

This juvenile specimen is very dark and extremely hard and shrunken. It is very probably a young *vulgaris*.

- (12) B.M., 1889.4.24.15. *Octopus tuberculatus* Blainville, Hoyle (1886); *Octopus rugosus* (Bosc.), Robson (1929). Challenger Coll., No. 122B, off Barra Grande, Lat 9° 9' S., Long. 34° 53' W., depth 32 fm, red mud, 10.ix.1873. C. 115a.

This specimen was identified as *O. tuberculatus* by Hoyle, but is not described. There are indications of the dorsal rhomb of papillae and the specimen is very probably referable to *O. vulgaris*.

SOUTH AFRICA

- (13) B.M., 1890.9.4.4. *Octopus rugosus* (Bosc), Robson (1929). Port Elizabeth, South Africa, H. S. Spencer. Bears manuscript label "*Octopus granulatus* Lam." C. 108.

A mature male with all the characteristics of *O. vulgaris*. The specimen is very hard but one spermatophore was recovered from Needham's organ and was found to be in a moderately good state of preservation. Its length (10.5 mm) gives an index that is typical of *vulgaris* (Table II). There are about 37 coils to the spiral

TABLE II.—Characteristics of adult male specimens referable to *Octopus vulgaris* Lam.*

| B.M. No. | LLI | CLI | PLI | SpLI | Horn Coils |
|---------------------|-----|-----|------|------|------------|
| <i>West Agrica</i> | | | | | |
| 1928.3.17.1 | 1.8 | 28 | 18.7 | 37.5 | 40-50 |
| <i>South Africa</i> | | | | | |
| 1890.9.4.4 | 0.9 | 50 | 16.7 | 35 | ca. 37 |
| 1924.9.9.11 | 1.8 | 30 | — | — | — |

* Symbols as in Pickford (1945).

horn, interrupted by two irregular regions of partial uncoiling. The direction of the spiral is reversed several times, as follows: 8 coils anticlockwise, about 6 irregular clockwise coils, an irregular break, 3 anticlockwise coils followed immediately by 5 clockwise turns, an irregular break, 8 anticlockwise coils followed by 6 clockwise. This repeated reversal of the spiral is not a characteristic feature of *vulgaris* spermatophores but there has been no large scale survey of spermatophore variation in this species and, in the absence of such data and of an adequate series of spermatophores from South African males, it seems unwise to attach any great significance to the condition. Apart from this feature the specimen appears to be a typical *O. vulgaris*.

- (14) B.M., 1924.9.9.11-13. *Octopus rugosus* (Bosc), Robson (1924 and 1929). Natal, Gilchrist Stns. 388 and 389. C. 105-107.

These specimens were identified but not described by Robson. The male has a minute ligula (Table II) and is apparently a typical *vulgaris*; there is one broken spermatophore in Needham's organ but it was not removed. The two females have ripe ovaries with small eggs. The specimens are rather small in size for sexually

mature females of *vulgaris* but are apparently referable to this species and resemble the male with which they were associated.

- (15) B.M., 1926.10.20.30. *Polypus granulatus* (Lamarck), Massy (1927); *Octopus rugosus* (Bosc), Robson (1929). Cape Colony, South African Museum 1311D. C. 109.

This female was described by Massy and indices based on her measurements are given in Table I. The specimen closely resembles the South African specimens from Natal, listed above, and similarly can be referred, in all probability, to *O. vulgaris*.

- (16) B.M., 1889.4.24.18. *Octopus granulatus* Lam., Hoyle (1886); *Octopus rugosus* (Bosc), Robson (1929). Challenger Coll., Simon's Bay, Cape of Good Hope, 10-20 fms. C. 114.

A very young specimen, with dorsal papillae in a characteristic rhomb, very probably referable to *O. vulgaris*.

In addition to the specimens listed above Robson's *type* of *Octopus rugosus* var. *sanctae helenae* (B.M., 1868.3.12.1) was examined but nothing new can be added to the original description (Robson, 1929). Although it is a badly distorted specimen with somewhat deceptive features there seems to be no valid reason why it should not be assigned to *O. vulgaris*. The same is true also of *Octopus verrucosus* Hoyle (1886) (B.M., 1889.4.24.16). The *type* of this species was fully redescribed by Robson (1929) who states that "It seems to exhibit characters of *O. vulgaris* and *O. rugosus* in combination with individual peculiarities." The distinctive features listed by Robson do not appear to be sufficiently diagnostic to justify recognition of this species as distinct from *O. vulgaris*.

The following summary is offered to clarify the present synonymy of *O. vulgaris*, in the light of the considerations outlined above.

Octopus vulgaris Lamarck

Octopus vulgaris, Robson (1929). All specimens from the north-eastern, north-western, central and south Atlantic, and from West and South Africa, which Robson refers to this species must be accepted as correctly identified. Specimens from the Indo-Pacific require further confirmation.

Octopus rugosus, Robson (1929). The majority of specimens from the eastern, western, central and south Atlantic, and from West and South Africa which Robson referred to this species are probably correctly assigned to *O. vulgaris*. It cannot be established that *O. rugosus* is a valid species. Some American specimens are referable to *O. briareus* Robson, and *O. joubini* Robson (Pickford, 1945, 1946), and one specimen from the Cape Verde Islands, described as a new species in the present contribution, must be excluded.

Octopus rugosus var. *sanctae helenae*, Robson (1929) = *O. vulgaris*.

Octopus verrucosus, Hoyle (1886), Robson (1929) = *O. vulgaris*.

Octopus vulgaris, Pickford (1945, 1946). The proposed synonymies of western Atlantic species appear to remain valid. *O. geryonea* Gray, *O. eudora* Gray,

O. filus Howell, *O. carolinensis* Verrill, and various other obscure western forms are assimilated into the synonymy of *O. vulgaris*.

Octopus vulgaris, Adam (1952). Probably all the West African specimens which Adam referred to this species are correctly assigned. No doubt would arise if it were not for the two specimens listed from the Cape Verde Islands, but not identified, which must be placed in a new species (see below).

There is an urgent need for the re-examination of specimens assigned either to *O. vulgaris* or to *O. rugosus*, *granulatus* or *tuberculatus* from the Indo-Pacific. As Robson has pointed out, the ligula of oriental specimens of *O. rugosus* (as understood by him) differs from that of Atlantic specimens; the average size is larger and the calamus shorter. A consideration of the data, so carefully assembled by Robson, appears to indicate that the Indo-Pacific *rugosus*-complex is composite in character and distinct from the Atlantic *rugosus*-complex. It is difficult to understand why he discarded this interpretation but one factor was the confusion that arose due to the inclusion of western Atlantic species that are not *O. vulgaris* in the synonymy of *O. rugosus*. The range of variation in critical characters, such as the length of the ligula, was thus enlarged in such a manner as to obscure the true situation.

Octopus vincenti n. sp.

Octopus granulatus (part), Hoyle (1886).

Octopus rugosus (part), Robson (1929).

Octopus sp., Adam (1952).

Holotype: Iles du Cap-Vert, 28.x.1948, Exped. Oceanogr. Belge côtes africaines de l'Atlantique Sud. Inst. Royal Sci. Naturelles de Belgique.

SPECIMEN EXAMINED:

B.M., 1889.4.24.17. *Octopus granulatus* Lam., Hoyle (1886); *Octopus rugosus* (Bosc), Robson (1929). Challenger Coll., St. Vincent, Cape Verde Islands, 25.iv.1876, depth 15–20 fms. C. 118.

In 1952 Adam listed a male and female from the Cape Verde Islands which were obviously different from *Octopus vulgaris*, but to which he hesitated to give a new name. The length of the ligula in the male is quite outside the range of *vulgaris* and the horn of the spermatophore is straight, without indications of uncoiling (Adam, Fig. 53D). These two features alone are sufficient to justify the recognition of a new species since no such males have hitherto been described from the eastern Atlantic. In addition the animal is of small size, mantle length 25–29 mm., the arms are short, the web deep and the suckers small, close to the lower limits for *O. vulgaris*. The female has a similar combination of characters but, on account of the great variability of *Octopus vulgaris*, Adam concluded that it was not possible to recognise the female as a distinct species.

During the course of the present investigation it was discovered that the male listed above, in the Collections of the British Museum, presented the same combination of characters. It was identified by Hoyle as *O. granulatus* and referred by Robson to *O. rugosus*, but under no circumstances can it be placed, along with other eastern Atlantic specimens of Robson's *rugosus* list, in the synonymy of *O. vulgaris*.

The size of the ligula alone precludes such an identification. The similarity to Adam's male is so great that there can be no doubt that the two specimens are conspecific. The only special feature of the British Museum specimen is the presence of a faintly darker area in front of the eye, about 4 mm. in diameter, which could possibly be interpreted as the remains of a faded ocellus; but this interpretation seems unlikely.

The British Museum specimen is not sexually mature and, in view of the highly distinctive spermatophores of Adam's specimen, which were in a good state of preservation and have been carefully figured, it seems preferable to designate this male as the *holotype*. The female, also from the Cape Verde Islands and with similar bodily features, is almost certainly referable to the same species but caution dictates that it should not be designated as the *gynotype*. It is unfortunate that the ovary was not sufficiently advanced for the size of the eggs to be determined.

The bodily proportions and characteristics of the three specimens are summarized in Table III. Adam did not describe either the funnel organ or the penis. Unfortunately the British Museum specimen does not allow one to give any account

TABLE III.—*Octopus vincenti* n. sp. *Tabular comparison of specimens.*

| Specimen | ML | MWI | HWI | MAI | WDI | SnI | Gill | LLI | CLI | SpLI |
|--------------------------|----|-----|-----|-----|-----|-----|------|-----|-----|------|
| Holotype: ♂ (Adam, 1952) | 29 | 55 | 59 | 50* | 34 | 9.5 | 10 | 6.2 | 40 | 55† |
| ♀ (Adam, 1952) | 25 | 72 | 60 | 40* | 22 | 9.0 | 10 | — | — | — |
| BM.1889.4.24.17, ♂ | 25 | 88 | 68 | 42 | 28 | 8.0 | 9 | 5.6 | 40 | — |

* Calculated from Adam's index (Longest arm/Mantle length).

† Calculated from Adam's Fig. 53 D₁ + D₂. It is not quite clear whether the two sections, horn and spermatophore respectively, show the complete spermatophore or whether a middle piece has been omitted. If this is the case the spermatophore length index would be greater.

of these characters. The funnel organ is too poorly preserved for description. The specimen had already been dissected and no sign of the penis remains; it was probably small and undeveloped since the animal is not sexually mature. There are no spermatophores.

DIAGNOSIS: A medium-sized species (mantle-length 24–29 mm.) with granular skin and bodily proportions similar to those of immature specimens of *O. vulgaris*. The arms are short, 2 to 2.5 times the length of the mantle, the first arms shortest. The web is deep, about one-third the length of the longest arm, the D sector deepest, the A sector shallowest. The suckers do not exceed 10% of the mantle-length and there are no specially enlarged suckers in either sex. The funnel organ is not known. The gills have 9 or 10 primary lamellae in each demibranch; the high number resembling that found in *O. vulgaris*. In the male the third right arm is hectocotylized and the ligula represents 4.5–6.2% of its length, the calamus opens near the middle, two-fifths of the distance from the last sucker to the tip of the ligula. The spermatophore is about half the length of the mantle and the horn is straight, without coils. The size of the eggs is unknown.

It may be enquired whether any other specimens, either among those listed by Adam or in the series from the British Museum can reasonably be assigned to this species. British Museum males have the characteristic minute ligula of *O. vulgaris*.

A juvenile male from the Cape Verde Islands (B.M., 1855.9.29.2) can also be excluded. The arms are longer and the web less deep, moreover the state of immaturity at a mantle-length of 31 mm. indicates that it is the young of a large species. The immature female from the Cape Verde Islands (B.M., 1851.1.24.1) with a mantle-length of 50 mm. may be excluded for similar reasons, including also the larger relative size of the suckers. Among Adam's specimens there are two males that have an unusually large ligula for *O. vulgaris* (Goree, 10.vi.1947, LLI 3.5; Goree, 24.ix.1946, LLI 2.9) but the spermatophore of the latter, illustrated by Adam (Fig. 53A), is typical of *O. vulgaris*, with a spirally coiled horn. Moreover in both these specimens the arms are long, the web only of moderate depth, and the suckers large as in *O. vulgaris*. Among females there is one (Goree, 31.i.1950) with unusually short arms, a moderately deep web, and small suckers, that might well be referred to this species. However, the characters of the females present no clear cut distinctions by which one species could be separated from the other. A clarification of the problem must await the capture of a gravid specimen; it may be anticipated that the ripe eggs may show some distinctive features.

It is unlikely that the sexually mature male of *O. vincenti* could be confused with any other Atlantic species. The differences between this species and *O. vulgaris* have already been discussed. In the western Atlantic there are four Caribbean species that have a ligula of approximately the same proportions as in *O. vincenti*. *O. briareus* Robson is readily excluded, the arms are long, the number of gill lamellae low, and the spermatophore horn is coiled. *O. joubini* Robson is a nearly smooth-skinned species with short arms, the spermatophore horn is straight but the number of gill lamellae is low, well below the minimum recorded for *O. vincenti*. The ocellate species, *O. hummelincki* Adam, has, in addition to this distinctive feature, a low number of gill lamellae and a coiled spermatophore horn. The nearest affiliation would appear to be with *O. burryi* (Voss, 1950, 1951). This species has a characteristic color pattern in the form of a purplish band which extends the full length of each arm on the inner (dorsal) side. Apart from this highly distinctive feature, it shows a general resemblance to *O. vincenti* and, in preparing a key for the separation of the two species it would be necessary to depend primarily upon the presence or absence of the purple arm band. Thus the arms are short, the web deep, and the number of gill lamellae high. The ligula is similar in size to that of *O. vincenti* and the horn of the spermatophore is nearly straight with only a few spiral turns (one proximal and three distal in the one that has been described).

The problem of *O. rugosus* in the Indian Ocean is so little understood that it would be futile, at the present time, to offer any comparison with these or other oriental forms.

My best thanks are due to Dr. W. J. Rees for facilities to study the British Museum specimens.

SUMMARY

1. Twenty-two specimens from the eastern Atlantic, the west African coast and South Africa which Robson (1929) identified as *O. rugosus* and which are now in the Collections of the British Museum have been re-examined.

2. Fifteen are either juvenile or sexually immature but, with one doubtful exception, they can reasonably be assigned to *O. vulgaris* Lam.
3. One juvenile specimen from Madeira has a peculiar zebra pattern on the arms and may therefore represent the young of some different species.
4. Six of the 7 adults show no features which would justify their separation from *O. vulgaris* Lam.
5. One adult male from the Cape Verde Islands is assigned to a new species. A male and female of this species were described but not named by Adam (1952) and Adam's male has been designated as the Holotype of *Octopus vincenti* n. sp.
6. The nature of the South African *vulgaris-rugosus* population is discussed and it is concluded that, at most, the South African specimens may represent a local race of slightly smaller size and with other minor differences, not specifically separable from *O. vulgaris* Lam.

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PART II.—A RE-EXAMINATION OF THE SPECIMENS OF *ROBSONELLA FONTANIANA* IN THE COLLECTIONS OF THE BRITISH MUSEUM

Robsonella (= *Joubinia*) *fontaniana* (Orbigny) is a well defined species, endemic to the subantarctic or antiboreal region of South America. Supposed records of this species from the Indian Ocean and from the Central Pacific are subject to the gravest suspicion, as pointed out by Robson (1929). Massy (1925) described a specimen from Natal which Robson has considered to be a local variety. Two closely related but supposedly distinct species have been described from Australia and New Zealand, viz. *R. australis* (Hoyle) and *R. huttoni* Benham. *Polyopus campbelli* of Smith is included in the synonymy of *R. australis* (Robson, 1929, footnote p. 145).

Robson (1929) placed *fontaniana* and *australis* (+ *campbelli*) in the new genus *Joubinia* but this was shown to be pre-occupied and the name *Robsonella* was substituted by Adam (1938). The characters of the genus were summarized by Robson and have been reviewed recently by Dell (1952). They are as follows: the arms are subequal, the web is deep and subequal, the mantle aperture is partly closed, the adlateral tooth of the radula is supposedly bicuspid, the penis has a long primary and a small secondary diverticulum, and the ligula of the hectocotylus is remarkably stout with inrolled sides and wide cheeks. We may disregard the characters of the arms and web since these are not of generic value. The partial closure of the mantle is also unimportant since many species of the genus *Octopus* have a slightly narrowed mantle opening of Robson's type B, moreover the mantle aperture is wide in *R. australis* (Benham, 1942). The long diverticulum of the penis is highly distinctive as a species character, common to all three forms, but there are species of *Octopus* which show a similar feature. The secondary diverticulum to which Robson attached great significance is apparently a variable feature since it was lacking in one of Dell's specimens of *R. australis*. There remains only the remarkably stout form of the ligula which may be conveniently retained, at least for the present, as a generic character. However it appears probable that the genus *Robsonella* is not a valid one and that the species which have been assigned to it should be returned to the genus *Octopus*.

A second problem concerns the validity of the distinction between *R. fontaniana* and the two Australasian species. Time did not permit a re-examination of the specimens of *R. australis* (+ *campbelli*) which are in the collections of the British Museum, but the material has been well described and we have also the accounts of Benham (1942) and Dell (1952) for comparison. The entire series of 11 specimens of *R. fontaniana* was carefully re-examined with a view to confirming and enlarging our concept of this South American species (Tables I and II). There are insignificant differences between the mean values of the indices as given by Robson (1929) and as determined here. In addition there are some features which call for further discussion.

TABLE I.—*Robsonella fontaniana* (Orbigny). Bodily characteristics of eleven specimens in the Collections of the British Museum.*

| B.M. No. | Sex | ML | MWI | HWI | MAI | WDI | SnI | SeI | Gill |
|------------------|--------|----|-----|-----|-----|-----|------|------|-------|
| 1851.1.24.5 . . | ♂ | 32 | 84 | 75 | 27 | 19 | 11.0 | 17.2 | 9.5 |
| 1869.6.5.54 . . | ♂ | 24 | 108 | 71 | 34 | 32 | 10.2 | 14.6 | 9 |
| 1869.6.5.65 . . | ♂ juv. | 19 | 84 | 68 | 28 | 16 | 10.5 | 13.2 | ca. 8 |
| 1869.6.5.69 . . | ♂ juv. | 19 | 100 | 55 | 35 | 18 | 6.8 | 9.5 | 10 |
| 1851.1.24.12 . . | ♀ mat. | 24 | 92 | 67 | 39 | 32 | 12.5 | — | 10 |
| 1848.6.16.2 . . | ♀ | 35 | 69 | 54 | 32 | 21 | 10.0 | — | 9 |
| 1869.6.5.63 . . | ♀ | 27 | 78 | 63 | 34 | 20 | 7.4 | — | 9.5 |
| 1868.7.10.2 . . | ♀ | 25 | 72 | 68 | 42 | 32 | 11.4 | — | 10.5 |
| 1899.8.31.84 . . | ♀ | 22 | 96 | 87 | 39 | 25 | 9.1 | — | 9 |
| 1869.6.5.62 . . | ♀ | 22 | 104 | 73 | 37 | 30 | 11.4 | — | ca. 9 |
| 1851.1.24.4 . . | juv. | 10 | 100 | 90 | 42 | 29 | 10.0 | — | 10 |
| Average . . . | | | 99 | 77 | 37 | 25 | 11.0 | 13.8 | 9.5 |

* Symbols as in Pickford (1945).

TABLE II.—*Robsonella fontaniana* (Orbigny). Characteristics of male specimens in the Collections of the British Museum.*

| B.M. No. | LLI | CLI | PLI | SpLI | Sp. Horn | Comments |
|-------------------|-----|-----------|------|--------------|----------|----------|
| 1851.1.24.5 . . . | 7.8 | 50 | 23.5 | 165 | No coils | — |
| 1869.6.5.54 . . . | 5.1 | 50 | 27 | 83 | One turn | — |
| 1869.6.5.65 . . . | | (damaged) | 18.5 | (not formed) | | Immature |
| 1869.6.5.69 . . . | 3.9 | 56 | 15.8 | (not formed) | | Immature |

* Symbols as in Pickford (1945).

Robson's sucker-diameter index does not distinguish between the diameter of the largest suckers of the normal series and the diameter of the specially enlarged suckers. It was found that such specially enlarged suckers occur only in males and are present in the four representatives of this sex that were examined. The penis of the two adult males is as figured by Robson, with an accessory knob-like diverticulum. The penes in the two immature specimens are similar but they lack the secondary diverticula. The ligula-length index averages 6.5 in the two adult specimens; as might be expected it is somewhat smaller in an immature male.

Two spermatophores were found in the larger male (B.M., 1851.1.24.5), lodged in Needham's organ, and one was removed for study. It is poorly preserved and doubled upon itself in a knot in the middle region. The estimated length of the horn plus middle piece is 38 mm., the sperm reservoir measures 15 mm. The total length is thus half as long again as the mantle (SpLI 165). The horn is dark and opaque and there is no evidence of coiling. Towards its distal end, i.e. proximal to the knot-like tangle, the inner tube has a moniliform appearance due to a series of three constrictions which are probably artifacts of preservation.

A single spermatophore was found in the smaller male (B.M., 1869.6.5.54). The horn plus middle piece measure 13 mm. and the sperm reservoir measures 7 mm.

The spermatophore-length index is thus lower than in the larger specimen (SpLI 83). The horn is straight except for a single widely-open turn of a spiral towards its distal end.

Nearly all the females are sexually immature with small and relatively undeveloped ovaries. However, the reproductive ducts are well developed and have been described by Robson. It may therefore be inferred that the specimens are spawned out or in a state of sexual quiescence rather than immature. Robson calls attention to the distal portion of the oviduct, or vagina, which is long and stout, but I find that this feature is somewhat variable. One specimen (B.M., 1851.1.24.12) has a well developed ovary with moderately large-sized eggs, *ca.* 3.5 mm. in length. The eggs are not fully ripe and the length of the stalk could not be determined. The vagina of this specimen is not abnormally stout.

DISCUSSION

Table III gives a comparison of indices and numerical characteristics of the species of *Robsonella*, compiled from data presented by Robson (1920), Benham (1942, 1943), and Dell (1952), and from the re-examination of the British Museum series of *R. fontaniana*. This table demonstrates the difficulty of assessing the

TABLE III.—Comparison of the species that have been assigned to the genus *Robsonella*.*

| Species | ML range | MWI av. | HWI av. | ALI av. | WDI av. | SnI av. | SeI† av. | Gill range | LLI range |
|--------------------------------|-------------|------------|------------|------------|------------|------------|-------------|---------------|--------------|
| <i>R. fontaniana</i> (Orbigny) | | | | | | | | | |
| B.M. Series† | 10-35 | 99 | 77 | (74) | 25 | 11.0 | 13.8 | 8-10 | 5.1-7.8 |
| <i>R. australis</i> (Hoyle) | | | | | | | | | |
| Robson (1929) | | | | | | | | | |
| <i>australis</i> | 22-33 | 81-86 | 62-73 | 72-76 | 33 | 11-13 | — | 6-9 | 10.8 |
| " <i>campbelli</i> " | 28 | 85 | 71 | 78 | 28 | ? | 21 | 10 | 8.5 |
| Benham (1942) | 10-36 | 79 | 62 | 73 | 24 | 12 | — | 6-8 | 8.4 |
| Dell (1952) | 11-30 | 76 | 63 | 73 | 27 | 10.6 | — | 6-8 | 4.5-4.7 |
| <i>R. huttoni</i> (Benham) | | | | | | | | | |
| Dell (1952) | 43-56 | 68 | 44.5 | 74 | 22 | 9.4 | — | 6-7 | 6.6-6.8 |

* Symbols as in Pickford (1945). Doubtful specimens from the Indian Ocean and Central Pacific excluded.

† Based on new measurements except for the arm-length index which is taken from Robson (1920) and which had to be used, instead of the mantle-arm index, to permit comparison with the published data for the other forms.

‡ Specially enlarged suckers found only in males.

|| Sexually mature specimens only.

differences between the three species. *R. huttoni* differs from *R. australis* in its larger size, narrower body and much narrower head but a familiarity with the complexities of octopodan taxonomy suggests that these features are difficult to evaluate. The same is true of the relatively somewhat smaller size of the suckers. Both these Australasian species differ from *R. fontaniana* primarily in the smaller number of gill lamellae; the ranges, however, overlap and the type of "*campbelli*"

has fully as many lamellae as a typical specimen of *R. fontaniana*. It must be remembered that an accurate count of the number of primary lamellae is highly subjective, depending upon the number of minute terminal foliations that are included in the count. However, the difference appears to be a valid one and must be accepted as such in the present state of our knowledge of these species. As indicated by Dell (1952) *R. huttoni* will probably prove to fall within the range of *R. australis*, but it is also evident that the Australasian specimens are at least racially distinct from the South American form.

A few more points may be discussed. The eggs of *R. australis* measure 2.5 mm. in length and have a short stalk (Benham, 1942). The eggs of *R. huttoni* are of about the same size, 3 mm. (Benham, 1943). Eggs, similar in size, measuring about 3.5 mm., are present in the ovary of a mature female of *R. fontaniana*, described here.

The characters of the hectocotylus and penis have been fully discussed by previous investigators and appear to offer no evidence for separating the species. Attention may be called to a curious error in Dell's paper, in discussing the affinities of *R. huttoni* he states on p. 40 that "The ligula index is appreciably lower than in *australis*—average 6.7 as compared with 10.8." But his table (p. 34, Table 9) shows that his own specimens of *R. australis* have a low index, averaging 5.4. The specimens appear to have been sexually mature since the presence of a spermatophore is mentioned in at least one of them.

The spermatophores of *R. fontaniana* are described for the first time. They are nearly as long as the mantle, or considerably longer. The horn is straight, as far as could be determined, or with a single distal turn, but admittedly the preservation is not good. Benham described and figured the spermatophores of *R. australis*. He states that they measured 40 mm. in length. The mantle-length of the male from which these spermatophores were taken is not given, but even his largest specimen has a mantle-length of only 36 mm. Therefore the spermatophore, like that of *R. fontaniana*, is about as long as or longer than the mantle. In the text Benham states that the "projectile apparatus" consists of a "closely-coiled spring". This would lead one to suppose that the horn of the spermatophore was coiled. However, a study of his figures (Benham, 1942, Figs. 6 and 7) suggests quite otherwise. The horn is apparently straight and what Benham mistook for the coils is clearly, in reality, the internal structure of the lumen which always has this delicate spiral structure, irrespective of whether the horn is straight or coiled (compare with the spermatophores of *O. macropus*, figured by Pickford, 1945, Pl. IV). The spermatophores of *R. huttoni* have not been described.

The author is indebted to Dr. W. J. Rees, for facilities to study these specimens.

SUMMARY

1. Eleven specimens of *Robsonella fontaniana* (Orbigny) in the Collections of the British Museum have been redescribed. The spermatophores, described for the first time are nearly as long as or longer than the mantle; the horn is straight or with a single spiral turn towards its distal end. The eggs are moderately large, ca. 3.5 mm. in length.

2. The status of the genus *Robsonella* is discussed. It is considered probable that the two Australasian species, *R. australis* (Hoyle, 1885) and *R. huttoni* (Benham, 1943) are synonymous but together they form an assemblage that is at least racially distinct from the South American species, *R. fontaniana*. The chief distinguishing characteristic is the lower average number of primary gill lamellae in the Australasian species.

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PRINTED IN GREAT BRITAIN BY
ADLARD AND SON, LIMITED,
BARTHOLOMEW PRESS, DORKING